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# Survey of hearing disorders in an urban population in Rondonia, Northern Brazil

## Inquérito de perdas auditivas em população urbana, Rondônia, Brasil

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### ABSTRACT

**OBJECTIVE:** To identify the prevalence of hearing loss for the population in the urban area.

**METHODS:** A cross-sectional household survey based on the World Health Organization Ear and Hearing Disorders Survey Protocol was conducted in 298 households in the urban area of Monte Negro, Rondonia, Northern Brazil, from 2005 to 2007. Ear examinations, behavioral audiometry and pure tone audiometry were conducted on 577 individuals.

**RESULTS:** The results showed that 3.8% (95%CI 2.17;5.45) of population were classified in the disabling hearing impairment category. The prevalence of moderate hearing impairment was 3.4%; severe impairment was 0.4%; and profound hearing impairment was not found.

**CONCLUSIONS:** The impairing hearing loss prevalence found in this study is within of the international prevalence for this level of hearing loss and smaller than observed in a previous study in the South region of Brazil.

**DESCRIPTORS:** Hearing Loss, epidemiology. Urban Zones. Cross-Sectional Studies.

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## RESUMO

**OBJETIVO:** Identificar a prevalência de perda auditiva da população urbana.

**MÉTODOS:** Estudo domiciliar transversal em 298 domicílios da área urbana de Monte Negro, RO, de 2005 a 2007. O estudo foi baseado no Protocolo de Pesquisa em Audição e Distúrbios da Audição, da Organização Mundial da Saúde. Exames de orelha, audiometria comportamental e audiometria tonal foram realizados em 577 indivíduos estudados.

**RESULTADOS:** Foram classificados na categoria de deficiência auditiva incapacitante 3,8% (IC95% 2,17;5,45) do total dos indivíduos estudados. A prevalência de deficiência auditiva moderada foi de 3,4%; deficiência auditiva severa foi de 0,4%. Não foi encontrada deficiência auditiva profunda.

**CONCLUSÕES:** O grau de prevalência de perda auditiva incapacitante encontrada no estudo foi equivalente à prevalência internacional para este grau e menor quando comparada ao resultado obtido em estudo anterior na região Sul do Brasil.

**DESCRIPTORIOS:** Perda Auditiva, epidemiologia. Zonas Urbanas. Estudos Transversais.

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## INTRODUCTION

Hearing impairment is the most frequent sensorial disorder for the general population, affecting over 250 million people worldwide, approximately 4.2% of the world's population.<sup>6</sup>

Researchers have tried to determine the prevalence of hearing loss in developing countries. Congenital permanent hearing impairment is an important health problem, not just in terms of prevalence but also in terms of the devastating consequences on speech and language acquisition if the condition is left undetected and, consequently, untreated.<sup>4</sup>

The World Health Organization (WHO) supports such studies for their strong relevance to public policies. Sixteen studies in ten countries that used the World Health Organization Ear and Hearing Disorders Survey Protocol<sup>7</sup> received technical support from the WHO. The hearing loss prevalence ranged from 2.1% to 8.8%.

There are few and scattered studies on hearing loss in specific Brazilian populations, e.g., in indigenous children in the central region of Brazil<sup>5</sup> and in elderly people in Rio de Janeiro, Southeastern Brazil.<sup>14</sup> There are no studies indicating the prevalence of hearing loss nationwide.

The most comprehensive national study using the World Health Organization Ear and Hearing Disorders Survey Protocol was carried out in the urban area of

Canoas, Southern Brazil, in 2003.<sup>2</sup> In this study, 2,427 children more than four year olds were evaluated. The population was composed of 1,040 systematically chosen households in 40 randomly selected census tracts (dwelling clusters). The prevalence of disabling hearing impairment is 6.8% (95% Confidence Interval – 95%CI 5.0;8.0); prevalence of moderate impairment is 5.4% (95%CI 4.4;6.4); severe impairment is 1.2% (95%CI 0.7;1.7); and profound hearing impairment is 0.2% (95%CI 0.03;0.33). Slight hearing impairment is 19.3%.

It is necessary to continue this study when we consider that Brazil is a country the size of a continent. There are regional particularities which may influence the population's general health profile, including hearing health, prevalence of tropical diseases in Northern areas, cultural characteristics which determine different habits of overall health care and the logistical difficulties imposed by the geographic and economic characteristics of each region.

A program in the fields of Dentistry, Speech Pathology and Audiology coordinated by the *Faculdade de Odontologia de Bauru* of the *Universidade de São Paulo* was initiated in the *Instituto de Ciências Biomédicas 5* (ICB5) in Monte Negro, Northern Brazil, in 2002. Following the audiological assessments carried out at the Oral Health and Speech Pathology Clinic, professionals identified subjects with hearing losses that varied in type and degree. The project to assess

the prevalence of hearing loss in the urban area of Monte Negro was conceived in order to outline the population's audiological profile, thus guiding public policy proposals to assist the hearing impaired in needy regions. This study aimed to identify the prevalence of hearing loss for the population in the urban area.

## METHODS

A cross-sectional study based on the World Health Organization Ear and Hearing Disorders Survey Protocol.<sup>7</sup> The study was developed in the urban area of Monte Negro, Rondonia, Northern Brazil, in April and July 2005, January and July 2006, and January and July 2007. In this period, six interventions were carried out. The urban population of Monte Negro consists of approximately 5,722 inhabitants (2,851 women and 2,871 men).

The sample size was calculated through the estimate of hearing loss and other hearing disorders prevalence of 7.0%, with an approximate error rate of 2.0%, and a 95%CI. The final number of the sample would be 1,345 considering the cluster sample and based on the statistical analysis.

According to the 2000 demographic census data, there were about four to five people in each household. To reach the sample size of this study, it was visited 298 homes.

The urban population was distributed into six census sectors, which included the industrial sector. These census sectors comprised 1,879 buildings.

A block was randomly chosen in every sector, and a corner chosen out of this block. All subjects living in the household were regarded as family members. The same methodology was adopted for each house visited, i.e., choosing from the first corner, walking to the left of one facing house 1, the fourth house, and then the eighth, the twelfth and so on, systematically. The houses chosen at random were visited by pairs of undergraduate and graduate Speech Pathology and Audiology students.

Individuals who did not reside in the home visited and those who were not found or refused to participate in the study after the third visit were excluded, as well as shelters, commercial buildings, lots, constructions and uninhabited houses.

Two out the six census sectors of the city studied had a smaller population base. In these two sectors, a greater amount of commercial buildings and uninhabited houses was found (285 are commercial buildings, 266 are uninhabited houses and the rest are inhabited houses). Owing to the difficult access to these two areas, the research was carried out in four of the six census sectors.

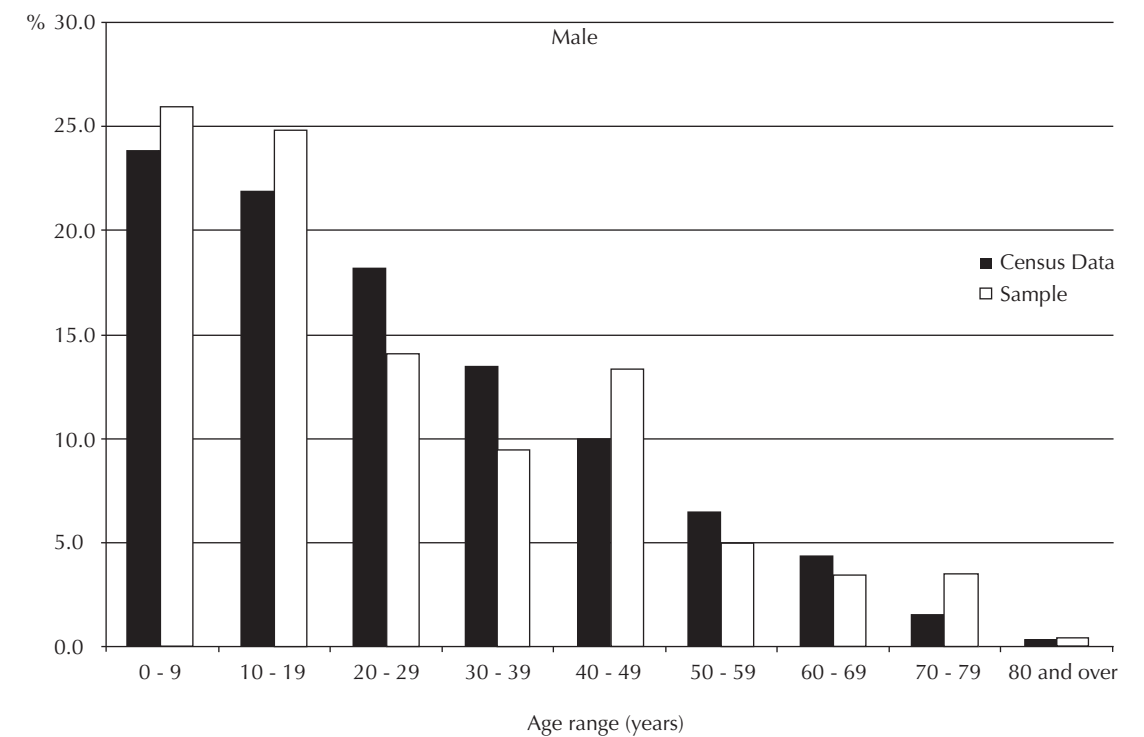
The 298 selected residences were visited. Out of the expected sample of 1,345 people, data were recorded for 609 individuals of both genders; 5.2% refused to participate or were not found following the three scheduled visits. A total of 577 individuals took part in the sample, with an estimate of hearing loss and other hearing disorders prevalence of 7.0%. The error level of 2.0% increased to about 3.5% and a 95%CI.

There were fewer persons per household than initially estimated. The households were randomly selected, which led to a significant number of commercial buildings, vacant lots and uninhabited houses. The number of subjects examined was lower than originally estimated; however, the population covered in terms of casuistic distribution was consistent with the age structure of the city as showed in the available census data (Figures 1 and 2).

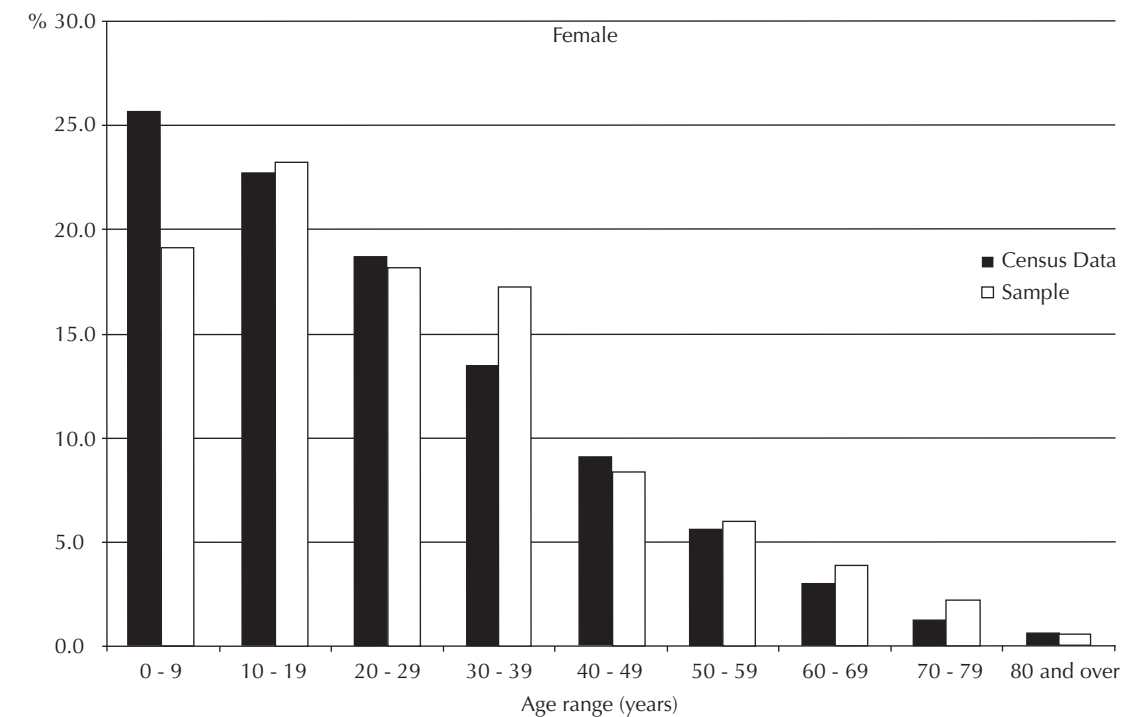
The biological calibration was performed through the pediatric audiometer (Interacoustics) to determine the normal hearing threshold, according to each frequency, to be used as a parameter in this research. The measurement of noise levels was performed in non-treated environments in the ICB5 building in Monte Negro to delimitate the scales of environmental noise in which the evaluation might be performed during the visits. The Bruel & Kjaer 2236 Sound Level Meter Type II was used. The values of environmental noise level found ranged from 50 to 66 dB Sound Pressure Level (SPL).

The hearing threshold between 0 and 20 dB hearing level was obtained for frequencies of 1 kHz, 2 kHz and 4 kHz in a normal-hearing child and an adult (controls) in the mentioned environment. These control subjects had previously undergone a conventional audiological evaluation in an acoustic booth, so as to confirm the absence of any hearing alteration. The maximum intensity of 66 dB SPL was established as the standard noise to be accepted in the houses visited. Determining the acceptable noise level in the houses visited was necessary to make the study feasible. These places and residences visited were located in a region of low socioeconomic level, and the internal acoustics of these constructions is not similar to those in large urban centers.

Prior to performing pure tone audiometry in the household chosen for the study, environmental noise was measured to identify a room that presented background noise similar or inferior to that tested in the facilities of the ICB5 building. The professionals controlled the variables, which might have increased the levels of environmental noise: electrical appliances were turned off, silence was requested, and pets were not allowed in the room, among other measures. Otoscopic inspection was performed prior to pure tone audiometry and a behavioral evaluation using a standard 2.5 V otoscope



**Figure 1.** Age distribution (year ranges) for the male sample in the study of hearing impairment, compared to the male population registered in Census data, Monte Negro, Northern Brazil.



**Figure 2.** Age distribution (year ranges) for the female sample in the study of hearing impairment, compared to the female population registered in Census data, Monte Negro, Northern Brazil.

**Table 1.** Prevalence of hearing impairment (better ear), according to levels of hearing impairment, Northern Brazil.

Better	Prevalence (%)	95%CI	
		Inferior limit	Superior limit
No impairment (0 - 29 dB)	84.8	79.7	88.8
Slight impairment (30 - 40 dB)	11.4	8.0	16.1
Moderate impairment <sup>a</sup> (41 - 60 dB)	3.4	2.1	5.4
Severe impairment <sup>a</sup> (61 - 80 dB)	0.4	0.1	1.4

<sup>a</sup> Moderate and severe impairment are classified as disabling hearing impairment

(Heine) for the visualization of the external hearing duct and the external portion of the tympanic membrane, with an approximate extension of 0.8 to 2.0 cm with regards to the speculums connected to the otoscope, respectively for adults and children.

The auditory behavior in children aged between zero months and three years and 11 months was evaluated. The test was performed with the examiner positioned behind the child, at a distance of approximately 50 cm from the child sitting on the lap of his/her mother or responsible adult. An observer stood in front of the child to describe all his/her behaviors. Ling sounds (/a/, /i/, /u/, /s/, /j/, /m/) were presented during the evaluation in normal speech intensity (between 60 and 70 dB SPL). Musical instruments such as the *agogô* (a sound with spectrum from 500 Hz to 20000 Hz, presenting two areas of greater intensity between 600 and 800 Hz, and between 3000 and 8000 Hz, where it reaches 85 (dB SPL) and the rattle were used. The evaluators observed the child's behavioral reaction (attention, detection, search, and localization) to the sounds presented, as well as the presence or absence of cochlear-palpebral reflex.

Pure tone audiometry was accomplished with the portable pediatric audiometer adapted to TDH-39 phones, correctly positioned to the ear, so as to verify whether or not hearing loss was present and characterize it the degree. The subjects were told to raise their hand whenever they heard the sound. Presentations started in 60 dB HL and were reduced in plateaus of 10 dB HL each time the individual responded to the stimulus presented, until reaching his/her hearing threshold, obtaining confirmation of responses following three consecutive presentations of the specific stimulus (pure tone). The hearing threshold was researched in the frequencies of 1 kHz, 2 kHz and 4 kHz, following the WHO.<sup>7</sup> The 500Hz frequency was not included because of environmental noise. An adaptation of the classification proposed by the WHO was used, which is: 0-29 dB, no impairment; 30-40 dB, slight impairment; 41 to 60 dB, moderate impairment; 61-80 dB severe impairment, > 80 dB, profound impairment.

This study was approved by the Ethical Research Committee of the *Faculdade de Odontologia de Bauru* of the *Universidade de São Paulo* (Protocol nº 89/2004). Participants were not identified and had their names protected. All participants signed an Informed Consent form as well as an Image Use Authorization form. The individuals presenting hearing alteration were referred for medical evaluation and, when possible, to an otorhinolaryngologist for later treatment whenever necessary. Those who presented hearing impairment benefited from the hearing aid (HA) provided at no cost and the team with the *Universidade de São Paulo* organizes periodical expeditions to monitor these people.

## RESULTS

Out of 577 individuals, 9.0% were between zero months and three years and 11 months, 29 males and 23 females. All children presented the expected auditory behavior for their age, showing absence of impairing hearing loss.

**Table 2.** Proportion (%) of individuals, by age group, with indicated hearing level in the better ear, Monte Negro, Northern Brazil, 2005-2007.

Age range	n	No impairment (0 - 29 dB)	Slight impairment (30 - 40 dB)	Disabling hearing impairment	
				Moderate impairment (41 - 60 dB)	Severe impairment (60 - 80 dB)
4 - 9	77	98.7	1.3	0.0	0.0
10 - 19	141	98.6	1.4	0.0	0.0
20 - 29	96	93.8	6.3	0.0	0.0
30 - 39	81	87.7	11.1	1.2	0.0
40 - 49	61	70.5	24.6	3.3	1.6
50 - 59	31	48.4	38.7	12.9	0.0
60 or +	21	28.9	39.5	28.9	2.6
Total	525	84.8	11.4	3.4	0.4

**Table 3.** Proportion of individuals with disabling hearing impairment, by sex and age groups, Northern Brazil.

Age range	Sex		Total
	Male	Female	
4 - 9	0.0	0.0	0.0
10 - 19	0.0	0.0	0.0
20 - 29	0.0	0.0	0.0
30 - 39	0.0	1.8	1.2
40 - 49	8.6	0.0	4.9
50 - 59	23.1	5.6	12.9
60 or +	42.1	21.1	31.6
Total	6.0	2.1	3.8

Three people presented profound mental impairing deficiency and were unable to perform the procedures proposed, being referred to objective audiological assessment.

Pure tone audiometry was carried out with 525 subjects, 233 male and 292 female.

Around 84.8% (95%CI 79.71;88.77) presented normal hearing and 3.8% (95%CI 1.95;7.11) were classified in the disabling hearing impairment category (Tables 1 and 2). The prevalence of moderate hearing impairment was 3.4%; for severe hearing impairment 0.4%; profound hearing impairment was not found (Table 1).

Hearing impairment increased with age (Table 2). Hearing loss, when present, was found in a slight degree for individuals aged < 30 years. Disabling hearing impairment was observed in subjects aged ≥ 30 years, the prevalence being greater in the age range above 60 years. The gender and age distribution of subjects with disabling hearing impairments indicated a difference between men and women, with a greater proportion of men with statistically significant difference (Table 3).

## DISCUSSION

The prevalence of disabling hearing impairment found was 3.8%, being 3.4% moderate hearing loss and 0.4% severe hearing loss, i.e., a smaller prevalence when compared to that obtained in the other study carried out in Brazil (6.8%). Monte Negro was founded 18 years ago, it is a very new city with a young population, with the highest proportions of males aged up to 19 years old (Figure 1) and up to 39 for females (Figure 2). Beria et al<sup>2</sup> (2007) presented 6.8% of impairing hearing loss prevalence and the greatest proportion of the population was found in the group

aged up to 49 for both males and females. Profound hearing loss was not found in this study, unlike the 0.2% prevalence described for the Southern population. Pure tone audiometry was accomplished with the portable pediatric audiometer adapted to TDH-39 phones, correctly positioned to the ear, so as to verify whether or not hearing loss was present, and if so, characterize it as to the degree.

It is not wise to determine that the data above mean the Northern region of Brazil presents lower hearing impairment prevalence compared to the Southern region. A considerable portion of the population of Monte Negro lives in rural areas and on local river banks in extremely needy conditions. Therefore, they are more susceptible to diseases and general health problems and this population was not included in the study.

The prevalence of disabling hearing impairment is quite varied when studies developed in several countries are analyzed, even if the same methodology has been used. Hearing health policies in countries such as Brazil, with so much regional diversity, should comprise a common actions nucleus, nevertheless, endowed with special conditions depending on local particularities. In regions such as Monte Negro, in which the access to specialized service is difficult, land and fluvial mobile units would be convenient options to get to hearing health reference centers, so as to reach the whole population. Although distinct from the Southern region of Brazil, the results found in the Northern region are within the international prevalence spectrum, since the smallest hearing impairment prevalence was found in Oman, 2.1%; and the greatest, 7.8%, in Northern Vietnam.<sup>7</sup>

The urban population studied is not provided with specialized hearing care. The population has virtually no knowledge of prevention and treatment of hearing impairment. The population is exposed to agents noxious to the hearing system, such as the noise produced by timber businesses, common in the region, and ototoxic drugs (quinine) used to treat Malaria, both of which are considered risk factors for hearing loss.

Prevention measures must be adopted so as to provide information to the population, qualify professionals and improve the services in these needy regions. The area of hearing health may be optimized through multimedia resources,<sup>1</sup> training courses, lectures, and some clinical procedures to integrate professionals from highly specialized centers with those of distant reference centers. The qualification of health community agents in these areas is feasible due to teleconsultation and distance education now possible.



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